Such a superiority is less obvious than usual in Dr. Spengel's production. Either Dr. Spengel was generously unwilling that the difference should be too striking, or Prof. Huxley's malign influence has extended to the German engraver and printer.

Considering the view which the translator appears to take of Huxley's "Manual," we were rather surprised that he should jeopardise his great reputation by undertaking the translation of so inferior a work. Our astonishment may easily be imagined on finding on the back of the work that the *authorship is attributed to Spengel as well as to Huxley*. The outside of the book, as seen on the book-shelf, reads thus :—

HUXLEY-SPENGEL
ANATOMIE
DER
WIRBELLOSEN THIERE.

The only explanation which occurs to us of this unusual blending of the names of author and translator is that Dr. Spengel felt that the prominence of his name was necessary in order to ensure, for the production of so feeble an anatomist and so imperfect a writer as Prof. Huxley, a circulation large enough to bring about the pecuniary result for which the translation was made. Men have been known to make translations for the sake of a sort of parasitic, or rather "commensal" reputation; but in this case, since Dr. Spengel seems to be the superior of Prof. Huxley, some other object must have been foremost in view.

Seriously speaking, we hardly think Dr. Spengel can have fully realised the effect which such a preface would have upon the ordinary reader. Had he done so his behaviour towards Prof. Huxley would have been of a kind for which we should hesitate to use adjectives adequately descriptive. F. M. B.

MERRIMAN'S "METHOD OF LEAST SQUARES"

Elements of the Method of Least Squares. By Mansfield Merriman, Ph.D., Instructor in Civil Engineering in the Sheffield Scientific School of Yale College. (London : Macmillan.)

THE method of least squares has an extensive literature of its own. Our author, in a sketch appended to his work, gives the titles of forty-seven of the most important memoirs and books which treat of this subject and of the law of errors of observation. He further "takes the wind out of the sails" of his reviewers by saying : "It would be easy to greatly extend the limits of this list. The titles have, in fact, been selected from a list of about four hundred, which I hope some time to publish, accompanied by historical and critical notes." Though this is an unkind cut, inasmuch as a reviewer will hardly care to bring forward any references of his own, we yet trust Dr. Merriman will be sufficiently encouraged to bring out this promised contribution to the history of a particular branch of mathematics. The writer's objects are "to present the fundamental principles and processes of the method in so plain a manner and to illustrate their application by such simple and practical examples as to render it accessible to civil engineers who have not had the benefit of extended mathematical training ; and secondly, to give an elementary exposition of the theory which should be adapted to the needs of a large and constantly-increasing class of students." Hence the book is both a practical and a theoretical one. The first part is concerned with the adjustment and comparison of engineering observations in which, after giving an introduction on the principles of probability and the method of least squares, he treats of direct observations upon a single quantity and independent observations upon several quantities, conditioned observations, and the discussions of physical observations.

The second part is devoted to the theory of least squares and probable errors ; in this, after a deduction of the fundamental principles, he proceeds to the development of practical methods and formulæ.

In an Appendix he gives Gauss's method of solving normal equations, a list of literature (referred to above), remarks on the theory of least squares, and a few other short notes. A full index is given at the end. There is frequent evidence that the writer has carefully consulted the memoirs he cites in his list, so that while there is nothing of novelty in his treatment that treatment is founded upon the best authorities.

"As I have not written for mathematical experts, they will doubtless find considerable (*sic*) in the book at which to grumble." He points out what may be considered blots in his book. One is that he has adopted Gauss's development of the law of probability of error as the best adapted to an elementary presentation ; "If this be objected to as defective, I claim at least the credit of knowing and of pointing out just what and where those defects are."

A consequence, perhaps, of having the work printed in this country is the list of errata. We would suggest in the event of the publication of the historical list, that the dates of reading of the memoirs should be given rather than (or at any rate in addition to) the dates of their publication.

We welcome this work as an evidence of the increasing attention that is being given to mathematics by the author's fellow-countrymen, and hope he will be encouraged by its reception here to follow up its publication with a promised work containing extended applications of the method to higher geodetic surveying and the other problems to which it can be and has been applied.

OUR BOOK SHELF

Holmes' Botanical Note-Book, or Practical Guide to a Knowledge of Botany. By E. M. Holmes, F.L.S., Curator of the Museum of the Pharmaceutical Society of Great Britain, late Lecturer on Botany at Westminster Hospital. (London : Christy and Co., 1878.)

FROM the author's experience at the Pharmaceutical Society, together with that gained during the time he held the lectureship at Westminster Hospital, he is likely to know pretty well the requirements of the students at the pharmaceutical and medical schools. It is not always, however, that a teacher, well acquainted though he may be with what is wanted by the students, is capable of providing the best material to supply those wants. In this note-book we think Mr. Holmes has succeeded in smoothing the path of the botanical course, often so uninteresting and consequently amounting to drudgery to many a student. The plan adopted of

arranging one part so as to work in with another, or rather to lead up to it, is a good one. The aim has been, not to simplify terms, which has often been attempted with varying success, but to reduce as far as possible the difficulty always attending a clear understanding of the meaning of the terms, and indeed to simplify the whole system of teaching. "To this end," the author says in his preface, "two charts of the natural orders are given, in which the diagnostic characters are reduced to a minimum, those which are most easily observed having been chosen as far as possible in preference to the more minute, while all the exceptions have been indicated in an appendix. It is hoped that in this way, the student being familiarised with all the exceptions likely to be met with in this country, some of the difficulties attending a practical study of botany will be removed." The three diagrams of scarlet geranium, daisy and dandelion, and narcissus will be found very useful, as each part of the plant is very distinctly named on the plate itself and is furthermore minutely described in two and a half pages of letterpress. The glossary with the Latin terms accented will be a great help to a young beginner and the interleaving of this part is a good point. Altogether we think the book is very satisfactory. We should, however, have preferred to see the sixty schedules placed at the end of the book rather than in the middle. Placed where they are, one is led to suppose there is no further matter beyond them, which is not the case, the charts and a very useful "Floral Calendar" being placed at the end.

Grundzüge der Electricitätslehre. Zehn Vorlesungen von Dr. W. v. Beetz. (Stuttgart: Meyer and Zeller.)

DR. VON BEETZ has published a series of lectures delivered to the members of the medical association in Munich. These lectures do not pretend to contain an exhaustive treatment of the subject. They are meant to illustrate the fundamental principles of the science by a series of well-devised experiments, and they amply fulfil the object for which they have been written. The little book contains much matter in a small space, and is throughout clear and to the point. It will be useful to a wide class of readers especially as an introduction to more detailed treatises. Objections might be raised against some incidental and more speculative remarks; but these are very few in number, and do not affect the chief aim of the book. A. S.

LETTERS TO THE EDITOR

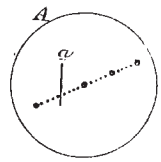
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Measuring Scales for Pocket Spectroscopes

IN using small spectroscopes, such as miniature pocket instruments, to examine coloured flames, and to discover to what particular substances they owe the characters of their radiation, the power of such discrimination which these instruments possess is for many reasons very limited and circumscribed if they are unprovided with some description of dark-field illuminated scale of regular divisions. I have found the following description of measuring scale, when adapted to such small spectroscopes, answer ordinary purposes of recording bright-line positions with them very well, although it was for viewing faint lines in auroral spectra that it was originally devised, for which I have not yet had an opportunity to test its suitability with the same success.

The circular disc A is a piece of copper foil in which a fine slit *a* is punched, and oblique to it a row of twenty holes is punctured, five on the left and fifteen on the right of the slit, the highest and lowest holes of the row being level with its top and bottom points. The actual size of the disc is just half the size of this figure, and to puncture the holes at equal distances apart of about $\frac{1}{80}$th of an inch, either a dividing engine must be used and a needle-point drawn along the sloping face of a straight edge is pressed down with the equal pressure of a weight upon the disc laid on zinc or ivory, to puncture it; or a rack of fifteen or twenty of the finest sewing needles, side by side, may be so fixed in fusible metal as to produce the whole row of punctures by a single pressure. But the first method, even with a roughly made dividing engine for the purpose, I have found the easiest and the most successful plan. The disc takes the place of the jaws of a pocket spectroscope, being dropped into a recess where it is covered by a glass plate and held in its place by a brass ring or perforated cap screwed upon the end of the spectroscope. When viewed through the prisms by sodium light it is seen magnified by the eye-lens, and the punctures form a scale of bright yellow points to the right and left of the yellow sodium line produced by the slit.



With sufficiently large punctures it is probable that the monochromatic yellow-green auroral ray would render the punctured scale visible in the same way that the sodium light does, so as to supply a measuring scale on which other spectral rays of the aurora's light besides the greenish one produced by the slit may be observed and recorded in their actual positions of distance from that leading line. Even the chief green ray of the solar corona in a total eclipse would not improbably illuminate the oblique scale sufficiently to allow the positions of other rays occurring in its spectrum to be recognised and mapped with ease and with considerable accuracy with a pocket spectroscope.

The object of inclining the row of punctures obliquely from a horizontal line is that other coloured images of it besides the principal or brightest one chosen for reference may not mix with and confuse its divisions. There is no means of varying the width of the slit in the arrangement, and I have not succeeded in obtaining microscopic scale photographs on glass sufficiently dense and opaque to replace the metallic punctured scales, and the focus of the eye lens for the yellow sodium points is not exactly the same as for very refrangible blue lines that coincide with them in position in the field of view; but an assortment of discs can be used and may be placed at pleasure in the cell, and the objection of the unequal focus is at least removable by using an achromatic lens. With these drawbacks to its use, however, the punctured scale has one essential advantage over laterally reflected ones, that its relation to the spectrum which it is used to measure always preserves an invariably fixed adjustment.

The presence of sodium light is so easily supplied where it is wanting that there are very few conditions (even if another bright spectral line cannot be chosen) in which the punctured scale is not available. The wave-length curve for each spectroscope is then easily constructed from observations of known elementary metallic lines in flame spectra in which the sodium line is always available for a line of reference. I have obtained this curve for both a punctured scale spectroscope and also for a Browning's miniature spectroscope with a reflected scale, and have examined several commonly occurring flames in furnace and other fires with the result of detecting in them some metallic spectra. Lithium is thus very often found, sometimes almost as bright as the sodium line, in coke furnace fires; and I have frequently observed in ordinary house fires a flame of rich blue colour with a very characteristic spectrum, which I now recognise by measurements as agreeing with that of copper chloride obtained by moistening copper foil with hydrochloric acid in a Bunsen-flame.

The accompanying figure (projected as nearly as the small size of the drawing permits, in tenth-metre wave-lengths) shows the appearance of the natural and artificial spectra, and their close resemblance, showing very clearly that some compound of copper is the cause of the very brilliant blue colour of the natural flame. Its finest exhibition in house-fires (where it quite filled a grate) arose from blazing wood-logs, which were described to me as broken-up ship-timber, in which traces of copper chloride might reasonably be expected to occur, and it is in the wood of fires that its hyacinth-blue flame has usually attracted my attention; but the same spectrum with three neat pairs of